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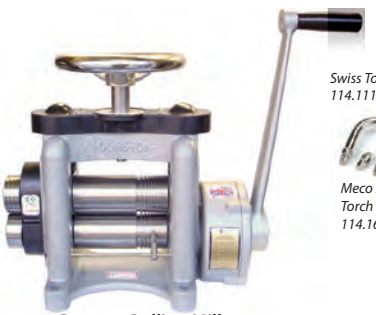

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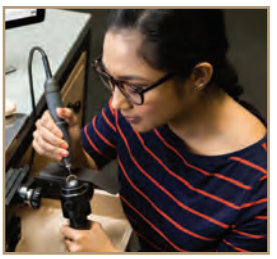

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METALSMITH TECH

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LIBER8 Technology
Targo Arc Bracelet, 2015
gold, E-link display

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Editor
Emily Zilber,
ezilber@snagmetalsmith.org

Contributing Editor
Kate Fogarty

Graphic Design
Luke Hayman,
Elyanna Blaser-Gould,
Pentagram

Advertising
John Garbett,
jgarbett@snagmetalsmith.org

Publications Committee
Sarah Archer, Nicholas Estrada, Kirk Lang, Tracy Steepy, Grace Stewart, Katja Toporski

SNAG Executive Director
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Each stage in the life of a jeweler or metalsmith offers opportunities to grow and change. We build new skills, both hard and soft. We connect with mentors and colleagues whose visions don't always mirror our own. We incorporate fresh ideas into the studio, add new elements to our practice, and find ways of working that may be more efficient, creative, and individually fulfilling. This desire to continue to learn across the twists and turns of an artistic life is at the core of all the stories in this issue of *Metalsmith Tech.*

Sarah Rachel Brown's personal essay centers on the development of a new set of skills in a field that may seem unrelated to the world of jewelry: podcasting. However, it is through taking on this passion project that Brown discovered more about herself as a jeweler than she might have at the bench. In "Game Plan," Mark Richard Leach discusses the challenges of thinking about the material and immaterial aspects of one's artistic legacy with Myra Mimlitsch-Gray, in a conversation that will prove intriguing to artists at all stages of their careers. Marlene Richey offers a savvy list of questions about pricing for any artist looking to sell their work, even those who think their systems are set in stone. Martha Glenny and Jeff Georgantes offer ideas on how to expand your studio practice through finishing and arc welding, including a list of practical resources. Chris Shea offers an intimate paean to the rivet and what it has taught him throughout his career, while Troy Richards and Wendy Yothers muse more broadly about how we can adapt jewelry education to reflect our changing world.

As this is only the second edition of *Metalsmith Tech,* themes of change and adaptability also resonate in the evolution of this magazine. Your input is an invaluable tool in making *Metalsmith Tech* a true resource. Please share story ideas and more by contacting me at editor@snagmetalsmith.org. I look forward to hearing from you.

—Emily Zilber, Editor

The mission of *Metalsmith Tech* is to focus on techniques, processes, educational philosophies and ideas, professional development topics, and new technology in the field of jewelry and metalsmithing. The magazine includes both contemporary and historical references, highlighting a diverse range of approaches to jewelry design and metalwork, including professional practices, creative influences, and new trends.

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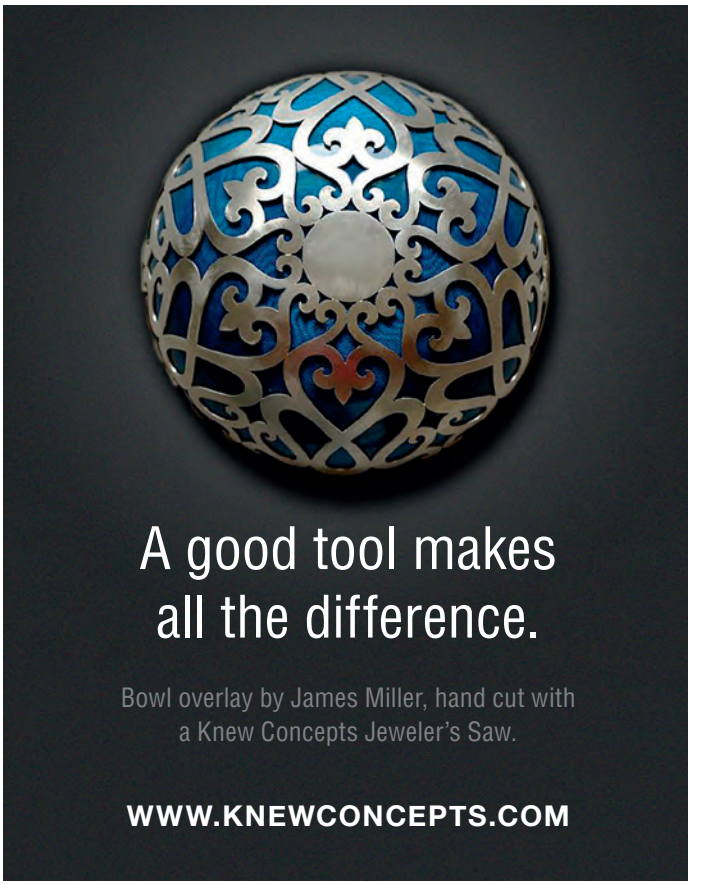

A good tool makes
all the difference.

Bowl overlay by James Miller, hand cut with
a Knew Concepts Jeweler's Saw.

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Chris Shea's handmade rivet header.
Photo: Chris Shea

Chris Shea
Limulous Door Knocker, 2015
steel, monel (nickel/copper alloy)
15 × 7.5 × 2 in.
Photo: Anything Photographic

TECH TOOLKIT

Riveted to the Spot

The tool of the moment reflects a career's obsession.

BY CHRIS SHEA

What constitutes an essential tool? It needn't be elaborate or expensive. At this moment, the tool I can't live without is a rivet header that I recently made from a bit of old coil spring.

I forged it rather crudely after reluctantly accepting that my current project needed round-headed rivets in the one size not already represented in my coffee can full of rivet headers. It's a simple steel shaft, about seven inches long, swollen at one end where a rounded punch has been driven in to create a domed depression. The working end came out notably off-center. I've resisted the urge to go back and clean it up for the photo accompanying these words. When I strike a hot iron rod with it, a pleasing domed head is left behind.

My love affair with rivets is longstanding, and amply documented in objects I've made over the past twenty-three years. There may be more dramatic or characteristic forms in my work, but the round-headed rivet is near-ubiquitous. I love rivets because they carry with them the history of metalwork, from suits of armor to the Brooklyn Bridge. Light spills over a domed head and flashes a bright spot amid the rough textures and hard facets of forged metal. It creates a pause, a punctuation mark among the nouns, verbs, and phrases of the overall design.

A rivet is a pragmatic little thing: two individual elements must be joined together, so a third element is made to pass through them both and expand on either end to clinch the two protagonists together. A simple blow with a hammer, without much regard to angle or other technique, will generally suffice to make a fully functioning rivet. With a bit of care, a hammer-faceted or extravagantly flattened rivet can evoke the process and the hand of the maker in appealing ways, while a domed rivet might come off as impersonal and standardized. For me, however, the round-headed rivet is less about the hand of the maker than it is about the hand of the user: the person who encounters a compelling object and instinctually *has* to touch it. A rivet is an invitation to trail a finger lightly along a surface and take a ride. (I get myself in trouble at museums that way.)

The ultimate measure of a tool is the impact it has — in this case, quite literally — on the object being made, and on the people that object reaches.

There can be great pleasure in making and using a highly refined tool. I have some of those too. But I find it good to remember that the ultimate measure of a tool is the impact it has — in this case, quite literally — on the object being made, and on the people that object reaches.

Chris Shea creates furniture and architectural metalwork at his studio outside Washington, D.C. His work can be found at www.chrisshea.com.

ROAD 2 SUCCESS

The Price is Right: A Guide to Successful Pricing

When pricing work, don't sell yourself short.

BY MARLENE RICHEY

Sophia Hu, who won the 2018 Best in Show for Rio Grande's Saul Bell Design Award with her "Origami - Window with a View" collection, has had to structure pricing differently for these diverse pieces. Photo: Rio Grande

Pricing your work is a subject that comes up over and over, even if you have been running a jewelry business for decades. Almost all of the designers I know, even the most experienced ones, are still unsure about how to price a certain piece, a valuable stone, or labor costs. This remains true even when you deeply understand your jewelry, your business, and the services you offer. You are not alone!

The following questions and tips will help you inform your pricing:

- Are you selling wholesale, retail, or both?
- Do you make one-of-a-kind pieces, limited production items, or a production line with multiples? Usually a production line will support your one-offs, which are harder to sell, more expensive to produce, and have a smaller audience.
- Visit craft shows, department stores, and boutiques to get a feel for the price range of pieces similar to yours, and better understand what the market will bear.
- What are you charging for labor — not only yours, but also that of any employees and subcontractors? Your labor costs should reflect the time it took to make a piece, as well as your expertise and experience in the field. If you are pricing a piece you will be making over and over again, don't price based on how long it took to make it the *first* time, but the time it took to produce the *tenth* version. You can't count your learning curve, experimentation, and mistakes in the price.
- Profit = Happiness! If you aren't making a profit, you won't be in business very long.
- Find the unique values in your work and consider them in the process. Handmade, handcrafted, made in America, environmentally friendly, good design, branding, copyrights, your story: all of these have value. Every jeweler or company values these qualities differently.
- Most designers increase their prices every year unless there are wild swings in the metals markets. I highly recommend the Kitco app (http://applications.kitco.com) or the Rio Grande website (www.riogrande.com) to follow the markets.
- Look at your pricing formula to see where you can streamline your production or cut materials costs without jeopardizing the design's integrity. If your piece is valued at $220, and you want to keep the price below $200 to sell more easily, what can you cut to bring it down? Can you use a less expensive clasp? Tighten the production? Use a smaller pearl? Make it a puzzle to be solved.
- What does your customer want from your jewelry? What sort of customer do you want to attract? What do they value? What is your customer willing to pay for a piece of your jewelry?

Throughout your career, you will have more questions about pricing — and there will be times when you overcharge or undercharge. It goes along with running a business. Learn as much as you can, experiment with your prices, and seek advice everywhere. And remember this lesson from a designer I've worked with: if you don't get any pushback on your prices, they are too low!

Marlene Richey is a consultant, author, professor, and advocate for art-based business, with more than thirty-five years of experience in jewelry, business, and design. She teaches a course on pricing as part of SNAG's Road 2 Success Entrepreneurship program (https://www.snagmetalsmith.org/resources-opportunities/r2s/) and writes regularly for the Rio Grande blog (http://riograndeblog.com).

This simple pricing formula I've developed works well as a general tool.

Cost of Labor + Materials = Cost of Goods Sold (CGS)

CGS x 2.0 (or 2.2 or 2.4) = Wholesale price

Wholesale price x 2.0 (or 2.2 or 2.4) = Retail price

When I co-owned a jewelry design firm, I kept a pricing worksheet on each piece. It was an invaluable tool not only for pricing, but also for reordering and reviewing.

An extended pricing worksheet is available at https://www.snagmetalsmith.org/metalsmith-magazine/metalsmith-extra

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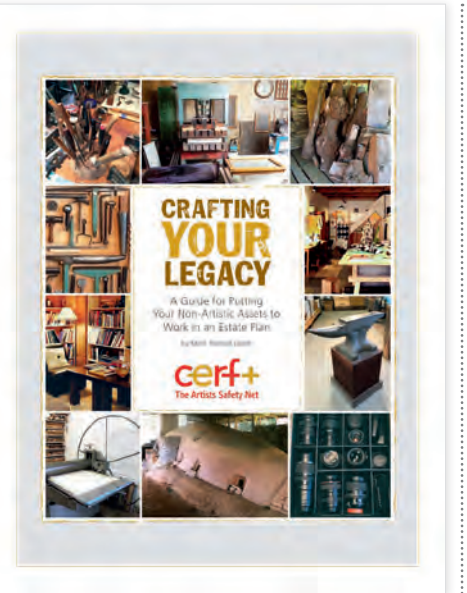
Opposite:
Myra Mimlitsch-Gray
Modified Corn Pone Pan, 2007
cast ductile iron
8.5 × 15.25 × 1.25 in.
Photo: Rich Maciejewski

Created in Arts/Industry, a long-term residency program of the John Michael Kohler Arts Center. Arts/Industry takes place at and is funded by Kohler Co., Sheboygan, Wisconsin.



GAME PLAN

Making a Permanent Mark: An Interview with Myra Mimlitsch-Gray about Legacy Planning

An artist reflects on the past while readying herself for the future.

BY MARK RICHARD LEACH

To many, an artistic legacy is the ultimate lifetime achievement. Often this story is only written after an artist's death. An obituary, catalogue raisonné, or a comprehensive survey exhibition are among the honorary tributes that can help define an artist's legacy. A legacy isn't just about artistic accomplishments, however: the imprint of an artist's creative activity can include teaching, writing, curating, organizing, and volunteering. Moreover, an artist's studio and its contents (tools, equipment, materials, library, and archives) can be important biographical reflections — and important assets — for a legacy vision.

More and more, artists are realizing the need both to think holistically about their creative legacy and to think long-term about the arc of their career while still in practice. Recently I interviewed sculptor and metalsmith Myra Mimlitsch-Gray while writing a workbook titled *Crafting Your Legacy: A Guide for Putting Your Non-Artistic Assets to Work in an Estate Plan* for the artist support organization CERF+. We spoke about her creative evolution, and her approach as a mid-career artist addressing estate- and legacy-related matters.

MRL: Have you taken an underlying approach throughout your career that you would describe as your signature?
MMG: I've considered my work within the field's trajectory from the onset, applying craft strategies that are borne out of traditional practice with the intent to move the outcome toward a critical realm. The nature of my inquiry is to pose broader questions through objects and acts of making. I want my work to stand in conversation with past models while opening new discourses, future speculations. I hope that it can somehow preserve the practice while continuing to provoke questions. I want the inquiry to continue long after my work is finished.

MRL: How do you think about originality?
MMG: It's hard to "own" any idea. I'm thinking about ways that my work refers to other models or modes of creativity, like my melted candelabra. It's not like I chose to reinterpret Dalí, but morphing and dissolving forms reflect the Surrealist psychology that interests me. In revising the role of familiar objects, I connect to the past. The critical object is what I'm going for, and I work to accomplish this goal by balancing preservation and critique, placing both into the same orbit, manipulating identity and value, through material and process.

Our field is *taught.* Not many pick it up without mentorship. It's challenging to provide a model and inspire individual approaches, especially when the practice can be very linear at times. It's easy for ideas to be repeated, restyled, or refined. Craft is, by definition, conventional. But as an artist, I long for less emulation and more innovation for our field.

MRL: As your ideas have evolved, have your tool choices expanded, too?

More and more, artists are realizing the need to think holistically about their creative legacy and the arc of their career while still in practice.

Myra Mimlitsch-Gray
Cup with Oval, 1998
silver
4.5 × 3.25 × 3 in.
Photo: Robert Sturm

MMG: I've worked with other materials and methods of making, but at some point, it was personally important to me to commit to a practice. The tooling can be very specific. Hammers may seem medieval to some, but they are as essential to my practice as it gets. Sometimes new concepts require retooling. My interest in enamelware led me to borrow a kiln and acquire accessories. The Kohler foundry residency introduced a whole new tool and skill set, but I couldn't take it home with me—my studio is way too tiny for that! [My time at] Kohler profoundly altered my sense of myself as an artist and craftsman, but I was passing through. The challenge became how to develop from that experience within the confines of my studio practice. Central to my practice is a need to reinvent and re-enchant the process, in synch with conceptual growth. I work with thin metal, always considering the air inside the form. I pursue the opportunity to create formal fictions. That's what I'm after, ultimately.

In some practical ways, I've circled the wagons around being a metalsmith. At the same time, I fully recognize that what I do is sculpture, too, especially in the sense that the objects operate as prompts: ideas in conversation with history, identity, and utility. My choices in this regard have limited the work's public exposure and acceptance because I seem to insist on being in multiple conversations at once. I hope someday this will be seen as a strategic, productive tension that impacted the discourse across disciplines.

MRL: Do you think that your tools and processes will play an integral role in how your legacy is articulated?
MMG: I imagine the pressure of a tool against the material. Part of the play is that the imagery is achieved with fairly simple tooling — hammers and stakes — and fairly direct means — construction, fabrication, and so on. But it has to be beyond a trompe l'oeil conclusion. I'm trying to combine that sense of pressure with my authoritative skill to incite a dialogue with the object in place, within a social circumstance. I magnify and exaggerate the material conditions to bring a sense of power to the work; a mythology about the craft, perhaps.

MRL: Like many artists, you have a website. Would you consider exploring certain digital means for creative and/or documentary purposes?
MMG: I have been fortunate to be the subject of interviews for the Smithsonian Archives of American Art, and for the

Myra Mimlitsch-Gray
Copper Craft Study: Pitcher, 2003
copper
5 × 14 × 9 in.
Photo: Robert Sturm

American Craft Council: both can be accessed digitally. My website is a work in progress; it mostly functions as a repository. I'm not a digital native, but I can imagine some opportunities to share my creative process in various formats that might make it more accessible. In terms of studio work, I am definitely "hands on," but I see the value in applying new technology when it is expedient.

MRL: Have you discussed any plans regarding the non-artistic assets of your estate, for example your bench, tools, archives, library, and other items of value?
MMG: Our conversation is making me realize there is much work to do! I have an outdated will in need of attention. I've spoken to certain people and described some of my wishes, but I certainly need to revisit all of this. I have promised tools to various institutions and individuals, but I need to do a proper inventory. Tools are tricky to place, because everyone has an anvil and many things already, but they also represent the continuity of the discipline. I want them to be used, not just placed on the porch with potted petunias.

"Tools are tricky to place, because everyone has an anvil and many things already, but they also represent the continuity of the discipline. I want them to be used, not just placed on the porch with potted petunias."

My library is more of a practical thing. I don't protect books as assets. Some have been handed down from mentors, artists, or colleagues, and I hand them around as well. I own my home where I maintain a studio. I have retirement assets and sometimes I'm conflicted as to how to allocate things. Beyond personal ties, I have promised funds for scholarships and recruitment at SUNY New Paltz and elsewhere, and support organizations that advocate for social justice.

MRL: Have you considered how some of your possessions might add to an understanding of your creative practice?
MMG: Beyond artwork, I haven't considered possessions as part of my legacy. I think it's important to place work in significant contexts that can stimulate future scholarship: research, publications, and curatorial projects. I will be providing educational scholarships to support young artist-scholars. The degrees I earned from Philadelphia College of Art (now University of the Arts) and Cranbrook Academy of Art are part of my legacy. As Professor and Head of the Metal Program at SUNY New Paltz, I'm part of an academic line of prominent scholars and craftsmen: I'm invested in protecting the program's legacy.

MRL: Do you own a collection of other artists' work? Have you thought about how its deposition might financially support your other estate or legacy objectives?
MMG: I have a small collection of artists' work that I need to consider. I'd like to find meaningful homes for the things I love. I need to begin to catalog this and identify places where such items would be welcomed, to ensure that my intentions will be honored. It's now time to holistically tie together this collection, my own work, and my possessions and complete my planning process.

Mark Richard Leach, who has served as executive director of the Southeastern Center for Contemporary Art in Winston-Salem and was founding director of the Mint Museum of Craft & Design, writes about the visual arts and is an independent curator and consultant.

Further Resources:
Crafting Your Legacy: A Guide for Putting Your Nonartistic Assets to Work In An Estate Plan (https://cerfplus.org/news/new-crafting-legacy-resource-available/).
Creating A Living Legacy (http://joanmitchellfoundation.org/artist-programs/call)

HOW I BUILT THIS

Lessons Learned: The First Year of *Perceived Value*

An artist sees jewelry through fresh eyes by creating a popular podcast.

BY SARAH RACHEL BROWN

"Great listening for anyone that knows the struggle and hustle of an artist's everyday life. This makes my studio time less lonely and makes me feel like I've made some friends along the way."
— Paige Harwell Samek, jeweler

A few years ago, I decided I was going to write a book that would feature profiles of artists' careers and how they make their living. It was going to be candid, specific, and highlight not only their accomplishments, but also their failures. This idea arose from my frustration with the lack of conversations in my creative community regarding the financial and logistical aspects of our careers. We often discuss how to make something, but we hardly discuss how to make a living.

Instead, I decided to play to my strengths — talking a lot and my congenial midwestern disposition — and developed *Perceived Value,* a podcast broaching the subject of value with artists. As I approach the one-year anniversary of my passion project, some reflection seemed appropriate. As both host and producer, my intention is to deliver radically transparent content with impeccable sound.

I haven't sat at my bench in over a month, but I've not been idle; I just needed to redefine what my studio practice looks like. Whether I'm soldering a ring or talking into a microphone, I am still being creative — and still being a jeweler.

Perceived Value has been an educational endeavor since the very first episode. As Shane Prada, Director of the Baltimore Jewelry Center, noted in episode 17, "Your job's about learning, which is cool." And I've learned a lot. I now know what an RSS feed is, and although I may not completely understand what a Master Fader does, I know it's necessary. Much like my studio practice, I'm figuring out what my time as a podcaster is worth, how to effectively promote the show, and creating my first marketing kit. It's all a work in progress, and the realizations I have gained about our community through this process and *Perceived Value* are invaluable.

As jewelers, the work we do is often solitary; it's just the tools, the jeweler's bench, and yourself. Podcasts have become a popular media to occupy our minds while our hands and eyes are focused. While I anticipated *Perceived Value* being a platform to share artists' stories; what I did not foresee is how it has become a way for artists to feel connected to their community. Through episodes such as "Creating Your Community: The Metals Collective" (episode 4) artists are reminded of the value of community and that they share similar intentions and struggles with others. Sometimes it's just nice to know you're not alone, even when you are physically.

When first discussing my concept for this podcast, I received words of both encouragement and caution. Last January, I had the tables turned on me when I was interviewed for the *Tales of a Red Clay Rambler* podcast. Host Ben Carter put it very well: "Money is often tied to security, and if you ask people about money, you're asking them what makes them feel secure." My very first guest, the jeweler Emily Cobb, fully embraced the mission of *Perceived Value* when she precisely broke down her income from her previous five years as an adjunct professor during episode 1, "The Adjunct Hustle." This remains one of my favorite conversations.

The radical transparency I request of my guests regarding their financial stability can make anyone feel vulnerable — and that's what makes the show successful. Vulnerability is powerful for how it draws you in and asks you to invest in someone, even if you don't — and likely won't — know them. What I assumed was going to be a challenging aspect for the podcast, asking artists to be vulnerable about their livelihoods in a public forum, has proven to be its greatest strength.

Opposite:
The author at her mic.
Photo: Ben Carter

A question I'm often asked that makes *me* feel incredibly vulnerable is, "When was the last time you were in the studio?" or even better, "Are you making new work?" I feel insecure around my productivity in the studio regardless of my actual output, and this topic often arises in my interviews. Social media is filled with accomplishments and process shots. We are obsessed with productivity, so hearing conversations that champion balance or broaden the definition of what makes one productive is refreshing. Jeweler Aurélie Guillaume expressed her goals on the topic in episode 15, recorded during Munich Jewelry Week: "I think this is what I'm going to try and find this year: balance between my work and myself. Taking care of myself."

As *Perceived Value* progresses, I'm dedicating the majority of my energy and time towards it. I haven't sat at my bench in over a month, but I've not been idle; I just needed to redefine *what* my studio practice looks like. Whether I'm soldering a ring or talking into a microphone, I am still being creative — and still being a jeweler. I've also learned that value is financial worth, but it is also purpose, significance, and power. I look forward to expanding the conversation in my second season.

Sarah Rachel Brown is the host and producer of Perceived Value *(https://www.perceivedvaluepodcast.com). She currently lives in Philadelphia where she holds down a full-time day job and hustles as a contemporary jeweler on her nights and weekends.*

TECH TALK

Precision Pulse Arc Welding and Traditional Torch Soldering: A Complementary Relationship

BY JEFF GEORGANTES

ANY CURIOUS KID who's ever stuck something that they shouldn't into a wall outlet knows the power of electricity. In simple terms, that is the theory behind arc welding, a process that jewelers and metalsmiths use as an alternative to soldering. Positive and negative leads come together in a controlled way to create a really hot spark. The space between the two leads creates an arc, which develops superheated plasma; hence the term *arc welding.* While arc welding is a great technology to incorporate into any studio practice, it best serves as a complement to traditional torch soldering, not a replacement.

PROBLEM SOLVING WITH ARC WELDING

While the worlds of industry and sculpture have understood the value of arc welding for decades, this technology is relatively new to the jewelry world. Soldering can create smooth, strong seams efficiently, and with a good solder color match, the seams are virtually invisible. Unfortunately, you can't solder next to heat-sensitive components, such as many stones, enamel, or patinaed metal. Also, you often have to devise complicated clamping mechanisms with multiple tweezers and third hands to hold the parts together, creating a visual obstacle which can make the perfect alignment of parts challenging.

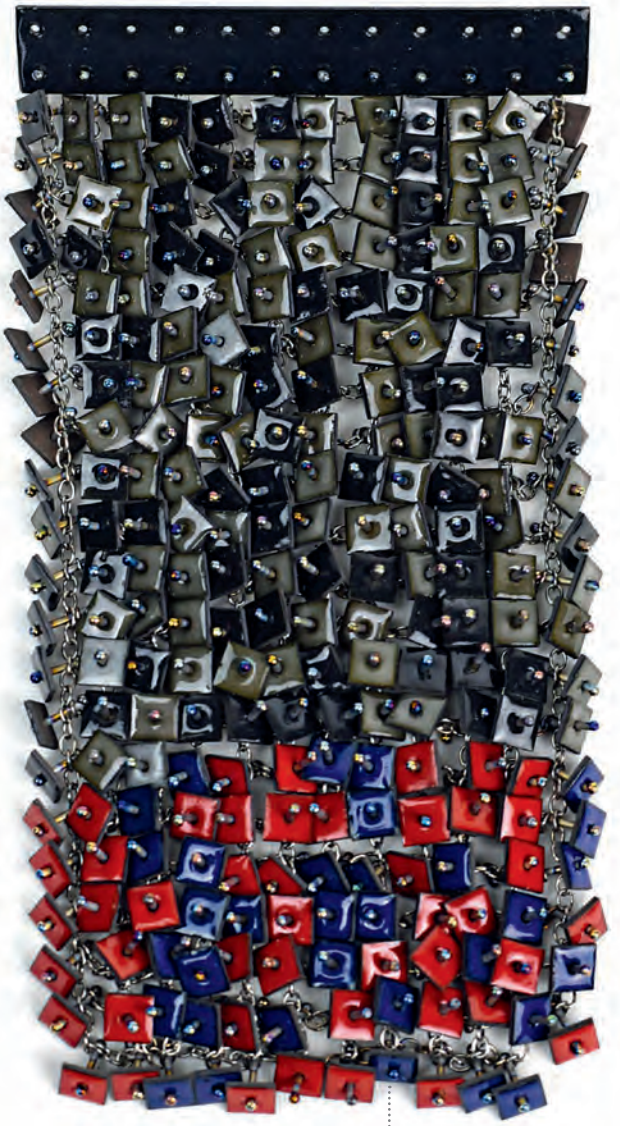
Over the last twenty years or so, laser welders have revolutionized jewelry fabrication and repair. The ability to weld metal with a concentrated beam of infrared light within less than 1 mm of a heat-sensitive stone is truly transformative. But while laser welders have come down in price, a good one is still close to $20,000 or more. The need for a less expensive alternative in our industry has led to the development of precision pulse arc welding for jewelry.

The metals that jewelers traditionally work with, like gold, silver, brass, copper, and bronze, tend to slump at red-hot temperatures, especially when thin. This new generation of precision-pulse arc welders for jewelry solves the slumping riddle by getting the metal alternately hot and cold in a series of millisecond-long welds.

USING ARC WELDING IN THE STUDIO

TIG (Tungsten Inert Gas) arc welding employs a tungsten electrode, usually connected to negative electricity, and another lead connected to positive electricity. The negative electrode touches the positive connected metal object, ignites a spark, and then is pulled away slightly to create an arc. A stream of inert gas (often argon) surrounds the arc to displace oxygen and replaces the need for any flux.

Precision pulse arc welders are very simple to use. With most of them, you click on the icon of the metal that you want to weld, then click on what kind of thickness and seam. The welders are



Melissa Cameron
covertly protesting the government, 2018
stainless steel, titanium, vitreous enamel; rivets set against fragile and heat sensitive materials with arc welder
4.3 × 2.4 × 0.4 in.
Photo: Melissa Cameron

preprogrammed to figure out the power, the duration of the weld, and the proper energy modulation. The electrode automatically retracts, which also automatically creates the arc. I spoke with Dr. Arron Astle, founder of Sunstone Engineering, which has a long history of making industrial welders and also manufactures Orion pulse arc welders. Astle says, "What we hope to bring to the jewelry industry is ... the technical expertise that we have from the industrial space, so the jeweler doesn't have to be an expert welder. They just have to know what they want to create. This is the goal in our products ... to let [jewelers] imagine something and just sit down and make it."

This new generation of precision pulse arc welders is extremely safe. The microscope is auto-darkening, so your eyes are completely protected from the harmful bright light. (You can also purchase an auto-darkening screen instead of a microscope.) These welders are grounded in a way that prevents you from being shocked. Also, because the energy happens in pulses, the welded metal usually gets warm slowly and you don't have to worry about being burned. You can even hold parts to be welded together with your fingers.

Sunstone's Orion 200i2 Precision Welding Technology

TO TRY WITH ARC WELDING

Removing Porosity from a Casting

1. Use a ball bur to remove porosity.
2. Weld to fill with same metal wire into the cavity. A good thickness for fill wire is 28 ga. (For sterling silver, some people prefer using fine silver, palladium silver, or argentium for fill wire.)
3. File, sand, burnish, and polish as necessary.

Bezel Setting

This is especially helpful with oddly shaped and large cabochons.

1. Measure, cut, and form bezel around stone.
2. Tack weld bezel together. (This weld ensures that the bezel doesn't reopen when soldering.)
3. Solder bezel.
4. Put stone into bezel with dental floss (for removal) onto base plate.
5. Tack weld bezel onto base plate about every 1/4 to 1/2 inch; remove stone.
6. Solder and finish jewelry object.

Tack Welding, Aligning, and Soldering

This works for many different components, from aligning settings and bails to making a hinge. Remember, you're welding, so the tack weld will be at a higher melting temperature than any solder, including IT solder.

1. Tack weld object in one point. That point will act like a hinge to move the part into perfect alignment. Weld again in two or more more spots to secure.
2. Solder with minimal or no clamping.

Tack Welding Multiple Parts Together Before Soldering Using Small Amounts of Glue onto Sheet Metal Connected to a Positive Electrical Lead

If using glue, remember that the glue will act as an electrical resist, so leave spots of bare metal touching bare metal. Use as little glue as possible. Also remember that the glue will burn, so only use this technique with adequate ventilation.

1. Cut and align parts onto sheet metal.
2. Partially glue them into place. If using Super Glue™ or similar glue, use a broken jeweler's saw blade to apply a tiny amount of glue.
3. Connect positive lead to themetal plate.
4. Weld all parts in one or two places.
5. Break the object free from the metal plate.
6. Solder all components together in one soldering operation.

Enameling

1. Assemble your object with precision pulse arc welding instead of IT solder before enameling.
2. If your object is already enameled and you need to attach a finding like an earring post, grind off the enamel to expose bare metal in two spots (one for the finding, the other for the positive electrical lead), then weld. It shouldn't hurt the enamel.

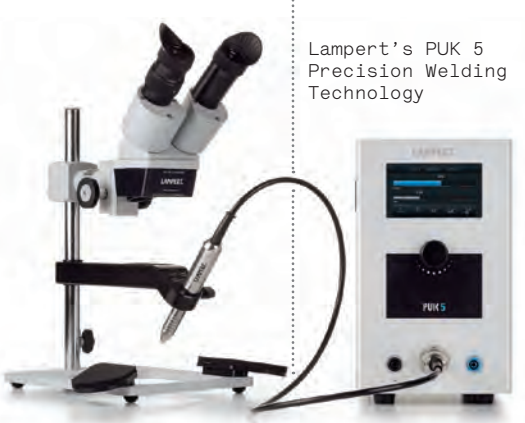
Welding a Ring for Sizing or Similar Joint

1. File a small V-shape into the joint about two-thirds through the thickness.
2. Weld and fill with same metal wire. A good thickness for fill wire is 28 ga. (For sterling silver, some people prefer using fine silver, palladium silver, or argentium for fill wire.)
3. File a small V-shape into the joint about two-thirds through the thickness on the other side of the joint.
4. Weld and fill with same metal wire.
5. File, sand, burnish, polish as necessary.

Welding to set a rivet

1. Practice First: Figure out settings and length of wire poking out of rivet hole.
2. Have the rivet wire poke out a small hole in paper or masking tape to protect the base plate from discoloration.
3. Touch electrode to the end of the wire to create a ball.
4. With practice you can ball up wire right up to something that's heat sensitive, like plastic, stone, enamel, and patinated metal.

Extended instructions and image examples for each of these possibilities can be found at https://www.snagmetalsmith.org/metalsmith-magazine/metalsmith-extra.



Lampert's PUK 5 Precision Welding Technology

Examples of Arc Welding

Jeff Georgantes
Multi-Level Geode Ring, 2018
sterling silver, 14 karat gold, rough geode, turquoise, amethyst; components tack welded, aligned, then soldered
2 × 1.75 × 1 in.
Photo: Case Hathaway-Zepeda

Andy Cooperman
Hexagonal Colony Government, 2017
sterling silver, 24 karat leaf, pearl, 14 karat posts; components tack welded then soldered, tops textured and joined with the welder
1.5 in.
Photo: Andy Cooperman

SOME OF THE ADVANTAGES OF PRECISION ARC WELDING

1. No flux. No pickling. No fire scale. Metal melts in a stream of inert argon gas.
2. Ability to weld metal next to heat-sensitive objects.
3. No need for clamping mechanisms; can hold parts with your hands.
4. Ability to tack in one spot and adjust for perfect alignment before soldering.
5. Can weld a variety of metals a little better than a laser welder, including silver, copper, brass, bronze, and steel — it's an enamellist's dream!
6. Most precision pulse arc welders use a microscope, so the potential for intricate detail is huge.

I interviewed Robert Sepiashvili from Lampert USA, makers of PUK welders, at the JCK 2018 trade show in Las Vegas. Robert described how the PUK system has evolved over the years to become an alternative to a laser welder, and how each model has gotten better and better. Precision pulse arc welders actually have a number of advantages over a laser welder. For instance, silver can be difficult to weld with a laser welder; it's very reflective, and will reflect the laser beam. Sepiashvili says, "The (arc) plasma will stay on silver, so it's like you're using a flame." Precision pulse arc welders do work a little better than a laser on copper, brass, and

Jeff Georgantes
Mendocino to Haystack, 2017
sterling silver, 14 karat, Haystack red granite, Mendocino Beach rock; components tack welded, aligned, then soldered
2.5 × 2.25 × .5 in.
Photo: Jeff Georgantes

Deborah Lozier
Pods of Color, 2018
liquid enamel on electroformed copper screen, waxed cotton thread, artificial sinew, leather cord; copper screen forms welded together, then electroformed and enameled
13 × 7 × 1.75 in.
Photo: Deborah Lozier

bronze as well. Gold and platinum work well on either a laser or a precision pulse arc welder.

This isn't to say that silver, copper, brass, and bronze are easy to weld with a precision pulse arc welder, as they are highly electrically conductive. Most people tend to increase the power with those metals, but often a better solution is to increase the time and duration of the pulse.

Seattle metalsmith Andy Cooperman recently told me, "I would never buy this technology to replace a torch. The welder certainly augments a torch — and in some cases can do the same job — but it's the things that a torch can't do that make the welder special. I knew from the very beginning that it would open new doors onto design and fabrication. So far I've only scratched the surface."

Sepiashvili adds, "No welder can replace the torch... Soldering will stay there. It's the right hand of any bench jeweler." So, if the torch is the right hand, then for me precision pulse arc welding is now my left hand. I highly recommend that you sit down with one of these welders at a jewelry trade show or equipment supply house, or a friend's studio. Or take a precision pulse arc welding workshop and try it for yourself.

WHICH WELDER TO GET?

Sunstone Engineering (Orion Welders) and Lampert Engineering (PUK Welders) are the primary companies making this technology for jewelry. I recommend that people try out different models and buy the welder that they can afford. Contact your favorite jewelry tool company for information about financing — that's what I did.

Jeff Georgantes is a metalsmith and head of the jewelry/metals program at Dartmouth College in Hanover, New Hampshire. Visit jeffgeorgantes.com to see more of his work. Special thanks to Sunstone Engineering, Lampert Engineering, Otto Frei, and Rio Grande for information for this article.

Further Resources:
PUK Welders - Lampert Engineering
www.lampert.info/en/home

Orion Welders – Sunstone Engineering
www.orionwelders.com

Jeffrey Herman PUK Blog
www.silversmithing.com/puk.htm#Blog

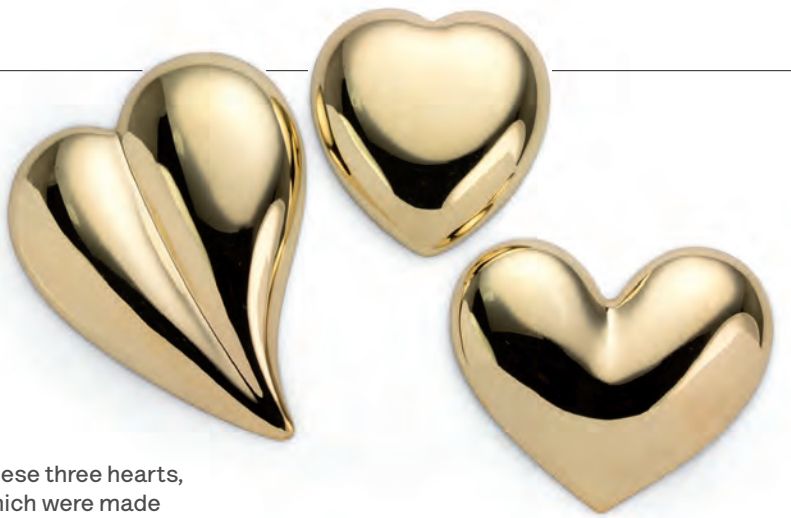
TECH TALK

Polishing to Perfection: Two Common Polishing Flaws and How to Fix – and Avoid – Them

BY MARTHA GLENNY

ON THE FIRST DAY of my classes in Metal Finishing at George Brown College in Toronto, I tell my students that the finish on a piece of jewelry is like the icing on a cake. Thoughtful and well-executed finishes tempt the jewelry viewer, just as we are drawn in by an artfully decorated cupcake. I go on to share this truism: If you can learn to execute a perfect mirror finish, you will be able to execute any finish — but the reverse is not true. Just because you have learned to apply a lovely hammered texture, or a scratch brush satin finish to silver or gold, you will not have the skills to polish and buff to perfection.

What is a perfect mirror finish? A well-polished surface will have a luster that is so highly reflective that you can see yourself in it, and the surface will be smooth, even, and free of flaws. And there's the catch. It is relatively easy to create a reflective surface using the appropriate polishing compounds and wheel buffs — but one that is smooth, even, and without flaws is more difficult to achieve. From my experience working with students, two problems stand out: drag lines and grooves. These flaws are not present in the metal surface before finishing, such as a scratch or dent, but are created by improper technique in the process of finishing.



These three hearts, which were made by George Brown students, have both a high luster and a smooth, even surface.

Photo:
Digital by Design

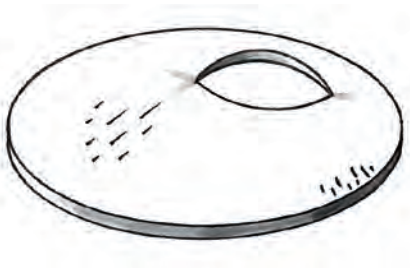
1

Paul McClure's work has well-executed finishing, with high luster and smooth surfaces on varying types of forms.

1
Paul McClure
Mutations Series: Capsid 1, 2011
sterling silver, lab grown corundrum, neodymium magnets
4.5 × 3.5 × 2 cm
Photo: Digital by Design

DRAG LINES

Drag lines, or "comet tails," are short lines that often start from a dot. They are usually found in groups of parallel lines but may appear singly. They indicate the direction of polishing.



Drag lines

Causes

Drag lines occur when imperfections in the metal surface are pulled into grooves by the action of the polishing wheel and compound. This occurs if the object is kept in one orientation for too long, and with too much pressure on the wheel. Drag lines can also result from polishing along the sanding lines you are attempting to remove.

Prevention

The best defense against drag lines is good technique. When preparing the metal for polishing, remove all imperfections in the metal surface with abrasives and work to the correct fineness for the polishing situation (object form, wheel type, and compound). Good polishing technique means polishing *across* sanding lines initially, and then polishing in all orientations. My rule is that every time the metal meets the wheel, it needs to be in a different orientation. This will prevent patterns from developing. And lastly, *look* at the surface every time you take the object away from the wheel to spot developing flaws so you can correct them before they become too deep. Changing orientation does not mean moving from horizontal to vertical repeatedly, but making small changes of orientation through 360 degrees. When looking at an object, be sure to look at the surface, not at the reflection. Use light from a single source, and roll the object in the light to inspect the surface. Rotate the object in all orientations and use magnification to assist identifying flaws.

Recovery

If you see that drag lines are starting to develop, immediately polish across the direction of the drags at a 90-degree angle to the lines. This will often remove them. Going forward, be sure to change polishing orientation often. If the drag lines are deep, you will need to return to sanding and create a new "clean" surface. My rule is to go back just one step. If you finished sanding at 400 grit, use that paper to remove drags, and return to polishing, employing good technique to prevent drag lines. It is not necessary to sand the entire form or repeat all the sanding steps.

Magnified drag lines in brass from a student exercise

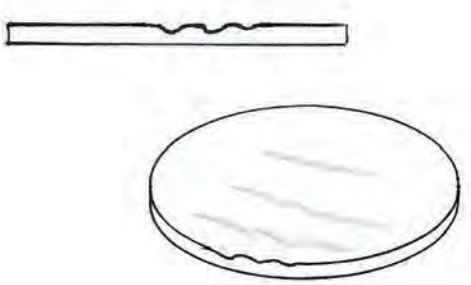
2

3

This ring and student exercises demonstrate how the reflections of a mirror finish can reveal differences in form.

2
Martha Glenny
Gold Ring, 1991
14 karat yellow gold
10 mm wide
Photo: Digital by Design

3
Leaf n' Swirls and Double Leaf forms
sterling silver
Photo: Digital by Design



Grooves

GROOVES

A grooved surface is one that is wavy. It shows "hills and valleys" in the metal surface. The surface may show one groove, or several parallel grooves.

Causes

If an object is applied to a polishing wheel (particularly a wheel with an uneven surface) in one orientation for too long and with too much abrasion, grooves can be cut into the metal.

Grooves can also result during lapping: holding an object part way onto the side of a felt lap, or angling an object into the edge when sliding it onto the lap, can cause the corner of the lap to cut into the metal. If the lap is not smooth, or compound is applied unevenly, grooves in the metal surface may be caused.

Prevention

When using a wheel buff, check the polishing surface before you begin. Does it need to be dressed, or does excess compound need to be removed? To create a new polishing surface, a dressing stone or a rake may be used against the working surface of the wheel while the lathe is turned on. A smooth or flat metal edge, even a scrap piece of brass or silver, is a simple tool to scrape away excess compound when the wheel is turning.

When polishing, continue to change orientation often, and do not repeat a pattern when bringing the object to the wheel. If the form does not allow the wheel buff to be used in different orientations, try using a wheel brush for initial polishing, then finish with a wheel buff and only apply compound when needed. A felt lap

Magnified grooves in brass from a student exercise

These works were designed to allow the best chance of a well-executed high polish: the areas with high polish are accessible to polishing tools and use texture to contrast mirror finish.

4
Martha Glenny
Over Under Ring, 1990
14 karat yellow gold, sterling silver
10 mm wide
Photo: Digital by Design

5
Martha Glenny
Angle of Repose: Fibonacci/ Jack-in-the-Pulpit, 2007
14 karat yellow and white gold
7 × 3 × 2.5 cm
Photo: Digital by Design

6
Martha Glenny
Brooch, 1992
14 karat yellow and red gold, Malawi garnet, diamond
50 × 20 mm
Photo: Digital by Design

4

5

should also be inspected prior to use, and dressed if the surface is lumpy. Apply compound evenly across the surface and carefully slide the object fully onto the lap parallel to the surface.

Recovery

If we think of grooves as hills and valleys, then to remove them you must sand the hills down to the same level as the lowest part of the valley to create a new flat surface. If the grooves are made with a wheel buff, sand the surface flat and then return to polishing. If the grooves are made when lapping and are not deep, you may be able to use the lap to cut down the hills. Orient the piece so the lap moves across the grooves.

Hills and valleys

If the grooves are in a corner or other tight area you can use a #6 cut barrette needle file to file down the high points. Use 400 grit paper and then 600 grit paper (3/0-4/0) over the file to sand. Wheel brushes can polish into the corner, and always change orientation as you are able.

The old saying "an ounce of prevention is worth a pound of cure" really *does* hold true for polishing jewelry. If you *look* at your work when polishing, *search* for flaws, and *correct* them immediately, then polishing is quick and easy.

TIPS AND FURTHER RESOURCES

- Design and plan your work to "build out" polishing problems: consider prefinishing before soldering; solder from the reverse; have alternate finishes on low areas, and mirror finish on high areas; remember that a slightly curved surface is infinitely easier to polish than a flat one; use contrast to bring emphasis to forms, surfaces, and points; and most importantly, choose surfaces with your tools in mind.

- Select surfaces that will enhance your work. A mirror finish will reveal three dimensionalities, particularly with curved forms, through reflection. Contrast brings emphasis to forms, surfaces, points. A polished surface in silver will tarnish much less quickly and is much easier to clean than a textured surface. This finish will maintain its original look for a longer time.

- The polishing kit we supply to our students at George Brown College includes a stitched yellow muslin wheel buff for polishing, a stitched soft muslin wheel buff for buffing, and wheel brushes. A small amount of Tripoli, Grey Star, and Rouge are also supplied.

- Polishing is a very personal process; we all have our favorite tools and tricks. I asked my colleagues to identify their favorite compound. Aside from Tripoli and Rouge, they cited Dialux Blue, Grey Star, Fabulustre, Lustre Bar, and Manhattan Bobbing compound on wheel brushes. Give these a try if they are new to you, and you might find a new favorite.

Martha Glenny is an educator and jewelry artist in Toronto.

Further Resources:
I have been making videos on polishing for several years, which cover different archetypal forms, tools, and equipment. Visit them at:
https://vimeo.com/channels/marthaglenny

6

THE NEXT GENERATION

Digital Meets Handmade: Conversations about Jewelry, Technology, and Education

BY TROY RICHARDS AND WENDY YOTHERS

IN MAY 2018, the Jewelry Design Department of the Fashion Institute of Technology (FIT) and the Jewelry and Accessories Division of the Politecnico di Milano collaborated to present the international symposium "Digital Meets Handmade: Jewelry in the 21st Century" at FIT in New York City. As planners of the event, we hoped to provide a venue for discussion of the friction between jewelry's "digital" and "handmade" influences, and stimulate conversation between artisans, the maker movement, and the digital engineering sector.

Thirty-seven speakers from across the U.S., as well as thirteen countries in Europe, Latin America, and Asia, addressed a range of topics. Four primary questions connected the broad conversation around how digital technologies and virtuoso handcraft can coalesce in the education of artists and jewelers:

- How can digital software and new forms of output support hand making techniques?
- How does direct manufacturing by 3D printing with precious metals change jewelry manufacturing, with regard to both aesthetics and profitability?
- How must we respond to the ways CAD and rapid prototyping are redefining perceived value, driving aesthetics, and creating new contexts for wearable art?
- What are best practices for bringing technology into the jewelry classroom, in regard to integrating CAD as an aid in ideation and tool making; introducing it into curriculum as a core aesthetic; or reimagining the way we might teach art and craft to a generation of digital natives?

We expected a collision of cultures. We were prepared to break up fistfights between "fine jewelry" craftsmen, who believe the sterility of CAD compromises their art, and engineers, who reckon the expediency of the technology is too obvious to question. We expected that artists who use CAD and rapid prototyping exclusively, as well as those who blend it with traditional handcraft, would lock horns with jewelers who use the "made-by-hand" quality of their work to create their distinctive brand and artistic voice.

We also anticipated conflicting views about the "tool mark" of CAD. Every tool in the jeweler's bench leaves a signature mark, and CAD is no exception. For example, Annika Pettersson presented on her study conducted at Konstfack University in Stockholm entitled "Glitch in the Copy: Digital Technology/Noise Artifact," which investigated the effects of copy and digital reproduction in relation to jewelry. Pettersson explored the phenomenon that occurs when an object is copied: it acquires "noise," or generational distortion, which can influence the aesthetics of the finished jewelry. The inherent glitches in the software can dictate the final form of the art. Glitches are also an inescapable aspect of CAD's tool mark.

Technology can have a "mind of its own" in other ways. David Fletcher, CMO of Cooksongold, the UK-based industry leader for direct precious metal 3D printing for jewelry and watches and a major jewelry supplier, pointed out that the digital process of direct precious metal printing has an embedded preference for organic forms. Even though the technology opens up possibilities, the process will inadvertently tweak design; if straight lines and geometry are your aesthetic intention, choose a different tool. Fletcher advocated for integrating technology where it makes sense. He stressed that combining direct

Can we reimagine the way we might teach art and craft to a generation of digital natives?

Bin Dixon-Ward
Bluestone Pavement Neckpiece, 2018
3-D printed nylon, ink
260 × 260 × 20 mm
Photo: Christopher Sanders

Marie Boltenstern
Resonance Collection bracelet and earrings, 2016
directly printed in 18 karat gold

manufacturing with bench skills can offer results neither process could accomplish on its own.

In a final panel titled "Has CAD Gone Bad?", we hoped for challenging dialogue and debate. A cross section of artists, inventors, and professionals broached the topic, including moderator Michael Coan from FIT; Matt Bennett, a technology authority in the jewelry community who is the Training Director for Gemvision and Stuller; Emily Cobb, who melds digital technology and handcraft in her jewelry and teaches at Humboldt State University in California; Bin Dixon-Ward, an artist who teaches digital modeling and 3D printing at RMIT University in Melbourne, Australia; and Christine Lüdeke, who developed the MA in Design and Future Making at Pforzheim University in Germany. Coan began by citing Robert Oppenheimer, the physicist often called "the father of the atomic bomb": "When you see something is technically sweet, you go ahead and do it and you argue about what to do with it only after you've had a technical success."[1]

Because the CAD technology we use for jewelry was created for the auto industry, for aerospace, and for munitions manufacturing, adapting it brings aesthetic challenges — especially if the designer doesn't want his or her jewelry to resemble cars, bullets, or planes. One might say that melding the digital with handmade is matching the perfect with the imperfect, the machine with the human being. Handcraftsmanship depends on spontaneous judgment, dexterity, and care. The quality of the result is continually at risk during the process of making: Will the graver slip? Will the emerald chip when I tighten the prongs? What if I try a new way? Spontaneity and risk are essential to art; in CAD, some argue, the risk is factored out and the results too perfect. Without that element of risk, can you use CAD to make real, scintillating art? Ultimately, nobody expressed sorrow that CAD's magic ability to streamline production might somehow curtail creativity. No one waxed nostalgic about eliminating risk. CAD is a tool to use — or leave alone. Slice it, dice it, swallow it whole, or put it aside.

The larger topic of re-imagining the university education model to serve the evolving needs of students — especially when it comes to the technological skill sets necessary to do justice to the generational transference of knowledge in our craft *and* to respond to the needs of industry — formed a large part of the symposium content. Though such discussions are often reduced to an idea that technology is bad and handmade is good, to do so runs the risk of ignoring more nuanced and complicated ideas, feelings, and histories behind the issue. It's important to remember that at any given time over the past century, there has always been someone, somewhere, arguing for the merits of traditional techniques and materials. The person arguing for the handmade may be termed a "Luddite," which is not far from the truth, but not in how we understand the term today. The real Luddites of nineteenth-century England were not opposed to all technology, but, as Kevin Binfield suggests, "They just wanted machines that made high-quality goods, and they wanted those machines to be run by workers who had gone through an apprenticeship and got paid decent wages."[2] Indeed, when we discuss the value of the handmade and whether to continue or abandon the traditions of different art forms, we invariably fret

Emily Cobb and Mallory Weston
Ssssmiley Face (front and back), 2017
nylon, metal leaf, gold-filled bronze, 18 karat yellow gold-plated brass, acrylic
1.25 × 12.25 × 18.5 in.
Photo: Emily Cobb
Courtesy: Siena Patti

over the disruptive incursion of new technologies. When we do, we share those Luddite concerns about the quality of our product and the pay of the worker.

A useful framework for this conversation, discussed during the symposium, was proposed by Justin Marshall in his paper "Craft and Technology from a Pragmatic Perspective."[3] Marshall discusses three different perspectives on technology: a conservative view that assumes a "technological imperative," meaning all innovation is positive and undeniable; a Heideggerian approach, which posits that technology is *enframing,* or extracts resources from nature, as with the "use of a hand chisel you can bring forth a wooden bowl that reveals aspects of natural woodiness and vesselness"; and Instrumental Pragmatism, as proposed by philosopher John Dewey, which understands technology and tools as an extension of man and sees thinking and doing as inseparable. Dewey argued for process, for "learning by doing," and objectives that are "provisional and evolutionary." As Marshall writes, "These 'ends in view' can be considered as plans which guide the ongoing process (e.g. the making of the artifact)."[4] Results can never be assumed or fixed but evolve through the process of making and inquiry. Marshall sides with Dewey's Instrumental Pragmatism, as do we as the organizers of this symposium. It is important to understand that such an approach does not blindly accept the utility of either new technology or traditional techniques. Lüdeke's solo presentation at the symposium, titled "Materializing Human Beingness through Digital Transformation," took this approach a step further. She asserted that the way we experience the world as filtered through digital technology is challenging the value we attach to the physical and material. This cultural shift will inspire new contexts for adornment, and even go so far as to lead us to redefine what it is to be human, as virtual experiences overtake real ones in our work, play, and imaginations.

If we expect critical thinking, adaptability, and lifelong learning from our students, we must be prepared to knock down a few walls and move the furniture.

What does this shift mean for jewelry education today? How do we best prepare students to enter into all facets of this industry, cultivating skills that encourage lifelong learning *and* adaptability to new knowledge and technologies? It is important that we acknowledge that our country's K–12 education is uneven and offer a means of evaluating prospective students who are interested in and passionate about art — even if they don't have the requisite portfolio for admission. Education should meet the student where she or he is, and not imagine where he or she should be. The approach we replace it with should value the skills and knowledge, often based in technology, that so many students bring with them. This means integrating technology into the first year of a college education. It means teaching the handmade alongside the digital in a problem-based approach reflective of Dewey's Instrumental Pragmatism.

Any educational model should respond to changes in industry, and work with industry to think ahead. College is a laboratory where new techniques and technologies, as well as new pedagogical models, are tested. It is constantly in flux with objectives that are, as Dewey proposed, "provisional and evolutionary." Sunyoug Cheong, a jeweler and adjunct professor

Zoltan David
Moonshine necklace from the Knightsteel Collection
steel, platinum, diamonds, moonstone
41 × 52.5 mm
Photo: John Parrish

at the University of Kansas, outlined an elegant and effective way to integrate and test new technologies as they apply to jewelry design and making. She moved the computers for design software into a workspace right next to the jewelry studio. Design, rapid prototyping, and traditional metalsmithing all take place within a few feet of one another. Cheong described how this shared space encourages students to move back and forth constantly, designing, testing, making, and revising. Removing the physical *and* psychological distance between digital and handmade allowed them to accelerate their exploration as artists and design engineers. If we expect critical thinking, adaptability, and lifelong learning from our students, we must be prepared to knock down a few walls and move the furniture.

This clear-eyed, pragmatic approach comes with a cost. There are limits as to how much can fit into a college education. As we continue to add new technologies and ways of making to the curriculum, we must ask, what can be given up? Each technique learned and every process or material explored requires an investment of time and resources by the student and the school. Perhaps it is not necessary for a student to master many techniques, but instead to have a foundation level that opens the door to further instruction or experimentation. The prioritizing of what should be taught must also consider that the future of art and craft is increasingly female and increasingly diverse: for example, eighty-five percent of FIT's students are female or female-identified and 65 to 75 percent of students in MFA programs are women.[5] To embrace this change, we should include in our curricula and course work projects that utilize processes, techniques, and technologies that stem from all over the world and acknowledge these perspectives.

Ultimately, whether a thing is made via the digital or handmade is not simply a binary question, but it *is* a vital one that has to be addressed as curriculum for secondary education programs in our field evolves. It is also just the first question that leads to so many more complicated ones. And with the information gleaned from each answer, one has to make choices that reflect our own needs as makers. This is where things get tricky — and where the fun begins. The historian Richard Sennett explains, "The experimental rhythm of problem solving and problem finding makes the ancient potter and the modern programmer members of the same tribe." Likewise, as Bin Dixon-Ward suggested during her talk, new technologies are an inevitable aspect in the natural evolution of our craft. They should be regarded as part of an unbroken, living thread of the human story, expressed and recorded in the things we make in response to our moment in time.

Troy Richards is the Dean of Art and Design at the Fashion Institute of Technology.

Wendy Yothers is a silversmith by trade whose work combines orthodox handcraft with every technology, ancient to modern, that can help bring her ideas to life.

Further Resources:
A full rundown/review of the symposium is at https://www.fitnyc.edu/jewelry-design/symposium/index.php. An ebook of the symposium findings is slated for publication on this website in 2019.

1 *In the Matter of J. Robert Oppenheimer, USAEC Transcript of Hearing Before Personnel Security Board* (1954) / **2** Binfield, Kevin. *Writings of the Luddites.* Johns Hopkins University Press, 2015. / **3** Marshall, Justin. *"Craft and Technology from a Pragmatic Perspective."* Paper presented at *Craft in the 21st Century,* Edinburgh School of Art, Edinburgh, UK, November 2002. / **4** Paper available at http://repository.falmouth.ac.uk/433/1/craft%20and%20technology%20marshall.pdf. / **5** https://nmwa.org/sites/default/files/shared/getthefacts_master-statistics_5womenartists.pdf / **6** Sennett, Richard. *The Craftsman.* Yale University Press, 2008.

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